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(71) Applicant: **Dreame Innovation Technology (Suzhou) Co., Ltd.**
Suzhou, Jiangsu 215104 (CN)

(72) Inventor: **SUN, Jiajia**
Suzhou, Jiangsu 215104 (CN)

(74) Representative: **dompatent von Kreisler Selting Werner -**
Partnerschaft von Patent- und Rechtsanwälten mbB
Deichmannhaus am Dom
Bahnhofsvorplatz 1
50667 Köln (DE)

(54) SELF-MOVING DEVICE AND DISTANCE MEASUREMENT METHOD FOR SAID DEVICE

(57) A self-moving device and a distance measurement method for said device, the self-moving device comprising a vehicle body (1), a movement assembly arranged on the vehicle body (1), and a control system arranged within the vehicle body (1); the self-moving device further comprises an optical reception apparatus (2) and at least two optical emission apparatuses (3) arranged on the vehicle body (1), at least two optical emission apparatuses (3) emitting light rays having different paths, and the optical reception apparatus (2) being able to receive reflected light rays formed via emitted light rays from at least one optical emission apparatus (3) hitting an obstruction. The self-moving device and the distance measurement method, by using emitted light rays that can be emitted in different paths, allow the area of the received light rays to become larger as an obstruction is approached, and the emitted light rays are formed by the addition of spectral reflection and diffuse reflection, thereby increasing the luminous intensity of light received and reducing the occurrence of non-uniform feedback distance due to obstructions having different reflectance.

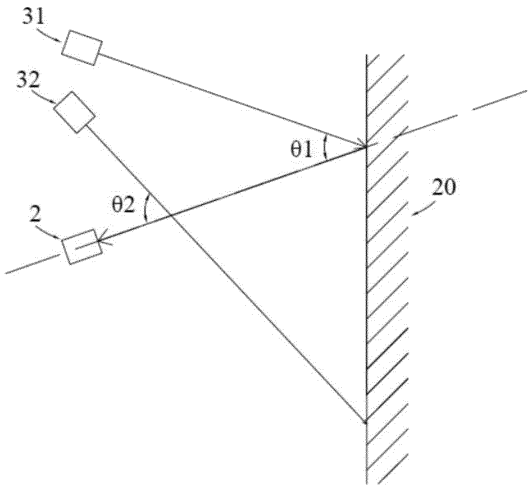

FIG. 3

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Description

TECHNICAL FIELD

[0001] The present application relates to a self-moving device and a distance measuring method thereof.

BACKGROUND

[0002] Self-moving devices, such as sweepers, cannot detect a distance information of obstacles with low reflectivity (such as black obstacles, etc.), so the self-moving devices cannot bypass such obstacles, and collisions will occur.

[0003] At present, a distance measuring sensor of the sweeper has a single structure and simple function, which can only achieve detours for obstacles with high reflectivity, but will hit obstacles with low reflectivity, thereby seriously affecting the user experience. For laser sensors with high distance measuring accuracy, the cost is high and it is not easy to popularize.

SUMMARY

[0004] An object of the present application is to provide a self-moving device and a distance measuring method thereof.

[0005] To achieve the above object, the present application provides the following technical solutions:

[0006] In a first aspect, a self-moving device is provided. The self-moving device includes a body, a walking assembly arranged on the body, and a control system arranged in the body. The self-moving device further includes an optical receiving device and at least two optical emitting devices arranged on the body. Paths of emitted light emitted by the at least two optical emitting devices are different. The optical receiving device is adapted to receive a reflected light formed after the emitted light emitted by at least one of the optical emitting devices hits an obstacle.

[0007] Further, the emitted light emitted by each of the optical emitting devices forms an included angle θ with a center line of the optical receiving device, and the included angle is greater than 0°.

[0008] Further, the optical emitting device farther from the optical receiving device in two adjacent optical emitting devices forms a first included angle with the center line of the optical receiving device; the optical emitting device closer to the optical receiving device forms a second included angle with the center line of the optical receiving device; and the first included angle is smaller than the second included angle.

[0009] Further, the at least two optical emitting devices are arranged on a same side of the optical receiving device.

[0010] Further, directions of the emitted light emitted by the at least two optical emitting devices are deviated toward the center line of the optical receiving device.

[0011] Further, the at least two optical emitting devices and the optical receiving device are arranged in a row.

[0012] Further, a detection range of the optical receiving device and the optical emitting device is within 2cm.

[0013] Further, the at least two optical emitting devices and the optical receiving device are integrated in one optical module.

[0014] In a second aspect, a distance measuring method of a self-moving device is provided. The distance measuring method includes:

at least two optical emitting devices emitting light with different paths; and

an optical receiving device at least receiving at least one reflected light formed after an emitted light emitted by the optical emitting device hits an obstacle.

[0015] Further, the emitted light emitted by each of the optical emitting devices forms an included angle θ with a center line of the optical receiving device, and the included angle is greater than 0°.

[0016] The beneficial effects of the self-moving device and the distance measuring method thereof of the present application are: by adopting the emitted light that can emit different paths, the area of the emitted light received is larger when it is closer to the obstacle. The emitted light is superimposed by specular reflection and diffuse reflection, thereby increasing the received light intensity and reducing the problem of inconsistent feedback distances of obstacles with different reflectivity, so that obstacles with low reflectivity can be effectively detected, and detours to the obstacles with low reflectivity can be realized.

[0017] The above description is only an overview of the technical solutions of the present application. In order to understand the technical solutions of the present application more clearly and implement them in accordance with the contents of the description, preferred embodiments of the present application and the accompanying drawings are described in detail below.

BRIEF DESCRIPTION OF DRAWINGS

[0018]

FIG. 1 is a schematic structural view of a self-moving device according to an embodiment of the application;

FIG. 2 is a flowchart of a distance measuring method of the self-moving device according to an embodiment of the present application; and

FIG. 3 is a schematic view of reflection when the self-moving device encounters an obstacle according to an embodiment of the present application.

DETAILED DESCRIPTION

[0019] The specific implementations of the present application will be described in further detail below with reference to the accompanying drawings and embodiments. The following examples are used to illustrate the present application, but are not intended to limit the scope of the present application.

[0020] Firstly, some terms involved in the present application are introduced:

[0021] A self-moving device can be, for example, a sweeping robot, a mopping robot, a dust-removing robot, an obstacle-removing robot, a lawn-mowing robot, a drawing robot, and the like. In some embodiments, in implementation, the self-moving device may be provided with a path planning system. The self-moving device moves according to the path set by the system, and performs operations such as cleaning, dust removal, wiping, and drawing. The self-moving device is further provided with a distance measuring unit, which is used to measure the distance between the self-moving device and the obstacle. The self-moving device will inevitably collide with obstacles during the working process. The self-moving device may also be provided with a wireless communication module such as a WIFI module and a Bluetooth module, so as to be connected in communication with intelligent terminals, and receive operation instructions transmitted by the user using the intelligent terminals through the wireless communication module.

[0022] An optical receiving device, such as an infrared receiver, is used to receive optical signals.

[0023] An optical emitting device, such as an infrared transmitter, is used to emit optical signals.

[0024] The self-moving device in the present application is a sweeping robot as an example. The distance measuring method of the present application is used to sense the existence of obstacles in the process of walking of the self-moving device. The distance measuring method can also be used in other self-moving devices that can realize self-moving control, while the application of the self-moving device is not specifically limited.

[0025] Referring to FIG. 1, the sweeping robot 10 provided in the embodiment of the present application includes a body 1, a walking assembly (not shown) disposed on the body 1, a control system (not shown) disposed in the body 1, an optical receiving device 2 and at least two optical emitting devices 3 arranged on the body 1. Paths of emitted light emitted by the at least two optical emitting devices 3 are different. The optical receiving device 2 can receive at least one reflected light formed after the emitted light emitted by the optical emitting device 3 hits an obstacle. In this embodiment, the optical receiving device 2 and the optical emitting device 3 are arranged on an upper surface of the body. The control system is signal-connected with the optical receiving device 2 and the optical emitting device 3. The control system controls the optical emitting device 3 to emit emission light (light emission signal). The optical receiving device 2 receives the emitted light (light receiving signal) and converts the emitted light into a light receiving signal and transmits it to the control system. The distance between the sweeping robot 10 and the obstacle is obtained by analysis and calculation by the control system, and then the sweeping robot is controlled by the control system to perform preset actions. Of course, in other embodiments, after receiving the emitted light, the optical receiving device 2 can also independently analyze and calculate the distance between the sweeping robot and the obstacle, and then transmit the result to the control system.

[0026] Alternatively, the emitted light emitted by each optical emitting device 3 forms an included angle θ with a center line of the optical receiving device 2, and the included angle is greater than 0°.

[0027] Alternatively, the optical emitting device 3 farther from the optical receiving device 2 among the two adjacent optical emitting devices 3 forms a first included angle with the center line of the optical receiving device 2. The optical emitting device 3 which is closer to the optical receiving device forms a second included angle with the center line of the optical receiving device 2. The first included angle is smaller than the second included angle.

[0028] Alternatively, at least two optical emitting devices 3 are arranged on a same side of the optical receiving device 2.

[0029] Alternatively, directions of the light emitted by the at least two optical emitting devices 3 are deviated toward the center line of the optical receiving device 2.

[0030] Alternatively, at least two optical emitting devices 3 and the optical receiving device 2 are arranged in a row.

[0031] Alternatively, a detection range of the optical receiving device 2 and the optical emitting device 3 is within 2cm.

[0032] Alternatively, at least two optical emitting devices 3 and the optical receiving device 2 are integrated in one optical module.

[0033] Referring to FIG. 2 and in combination with FIG. 1, the distance measuring method of the sweeping robot 10 of the present application includes:

S1: at least two optical emitting devices 3 emitting light with different emission paths; and

S2: an optical receiving device 2 at least receiving a reflected light formed after the emitted light emitted by the at least one optical emitting device 3 hits an obstacle.

[0034] Alternatively, the emitted light emitted by each optical emitting device 3 forms an included angle θ with a center line of the optical receiving device 2, and the included angle is greater than 0°. Among two adjacent optical emitting devices 3, the optical emitting device 3 which is farther from the optical receiving device 2 forms a first included angle with the center line of the optical receiving device 2. The optical emitting device 3 which

is closer to the optical receiving device forms a second included angle with the center line of the optical receiving device 2. The first included angle is smaller than the second included angle.

[0035] In summary, the sweeping robot 10 and the distance measuring method thereof adopts the emitted light that can emit different paths, so that the area of the received emitted light is larger when it is closer to the obstacle. The emitted light is superimposed by specular reflection and diffuse reflection, thereby increasing the received light intensity and reducing the problem of inconsistent feedback distances of obstacles with different reflectivity, so that obstacles with low reflectivity can be effectively detected, and detours to obstacles with low reflectivity can be realized, and the detour distance can be consistent.

[0036] A specific embodiment will be described in detail below. Referring to FIG. 1, in this embodiment, the number of the optical emitting devices 3 is selected to be two, including a first optical emitting device 31 and a second optical emitting device 32. The number of optical receiving device 2 is one. The paths of the emitted light emitted by the first optical emitting device 31 and the second optical emitting device 32 are different, but both are deviated toward the optical receiving device 2. The first optical emitting device 31 and the second optical emitting device 32 are arranged on the same side of the optical receiving device 2. The first optical emitting device 31, the second optical emitting device 32 and the optical receiving device 2 are arranged in a row. The first optical emitting device 31 is disposed farther from the optical receiving device 2 than the second optical emitting device 32. Taking directions of FIG. 1 as an example, a direction of arrow a in FIG. 1 is a left-right direction, and a direction of arrow b is a moving direction of the sweeping robot 10, which is defined as a front-rear direction.

[0037] The first optical emitting device 31 and the center line of the optical receiving device 2 form a first included angle $\theta 1$ greater than 0°. The second optical emitting device 32 and the center line of the optical receiving device 2 form a second included angle $\theta 2$ greater than 0°. The first included angle $\theta 1$ is smaller than the second included angle $\theta 2$. In addition, in FIG. 1, the center line of the optical receiving device 2 is shown by a dotted line x. In this embodiment, the reflected light received by the optical receiving device 2 is the reflected light formed after the emitted light emitted by the first optical emitting device 31 hits the obstacle. Therefore, in FIG. 1, the center line overlaps the reflection line of the first optical emitting device 31.

[0038] The technical features of the above embodiments can be combined arbitrarily. In order to simplify the description, all possible combinations of the technical features in the above embodiments are not described. However, as long as there is no contradiction in the combination of these technical features, they should be considered to be within the scope of the description in this specification.

[0039] The above examples only represent several embodiments of the present application, and the descriptions thereof are relatively specific and detailed, but should not be construed as a limitation on the scope of the present invention. It should be noted that, for those skilled in the art, without departing from the concept of the present application, several modifications and improvements can be made, which all belong to the protection scope of the present application. Therefore, the scope of protection of the patent of the present application shall be subject to the appended claims.

Claims

1. A self-moving device, comprising: a body, a walking assembly arranged on the body, and a control system arranged in the body, the self-moving device further comprising an optical receiving device and at least two optical emitting devices arranged on the body, paths of emitted light emitted by the at least two optical emitting devices being different, the optical receiving device being adapted to receive a reflected light formed after the emitted light emitted by at least one of the optical emitting devices hits an obstacle.

2. The self-moving device according to claim 1, wherein the emitted light emitted by each of the optical emitting devices forms an included angle θ with a center line of the optical receiving device, and the included angle is greater than 0°.

3. The self-moving device according to claim 2, wherein the optical emitting device farther from the optical receiving device in two adjacent optical emitting devices forms a first included angle with the center line of the optical receiving device; the optical emitting device closer to the optical receiving device forms a second included angle with the center line of the optical receiving device; and the first included angle is smaller than the second included angle.

4. The self-moving device according to claim 2, wherein the at least two optical emitting devices are arranged on a same side of the optical receiving device.

5. The self-moving device according to claim 2, wherein directions of the emitted light emitted by the at least two optical emitting devices are deviated toward the center line of the optical receiving device.

6. The self-moving device according to claim 3, 4 or 5, wherein the at least two optical emitting devices and the optical receiving device are arranged in a row.

7. The self-moving device according to claim 1, wherein a detection range of the optical receiving device and

the optical emitting device is within 2cm.

8. The self-moving device according to claim 1, wherein the at least two optical emitting devices and the optical receiving device are integrated in one optical module.

9. A distance measuring method of a self-moving device, comprising:

at least two optical emitting devices emitting light with different paths; and
an optical receiving device at least receiving at least one reflected light formed after an emitted light emitted by the optical emitting device hits an obstacle.

10. The distance measuring method of the self-moving device according to claim 9, wherein the emitted light emitted by each of the optical emitting devices forms an included angle θ with a center line of the optical receiving device, and the included angle is greater than 0°.

11. A self-moving device, comprising: a body, a walking assembly arranged on the body, and a control system arranged in the body, a front portion of the body being provided with an optical generating device and at least two optical emitting devices, the at least two optical emitting devices being arranged side by side, the optical emitting device farther from the optical receiving device forming a first included angle with a center line of the optical receiving device, the optical emitting device closer to the optical receiving device forming a second included angle with the center line of the optical receiving device, the first included angle being smaller than the second included angle, the closer the self-moving device being to an obstacle, the larger an area of the emitted light received by the optical receiving device.

12. The self-moving device according to claim 11, wherein two optical emitting devices are provided; and wherein a reflected light formed after the emitted light emitted by the optical emitting device far from the optical receiving device hits the obstacle overlaps the center line of the optical receiving device.

13. The self-moving device according to claim 11, wherein the at least two optical emitting devices are located on a same side of the optical receiving device, and directions of the emitted light emitted by the at least two optical generating devices are deviated toward the center line of the optical receiving device.

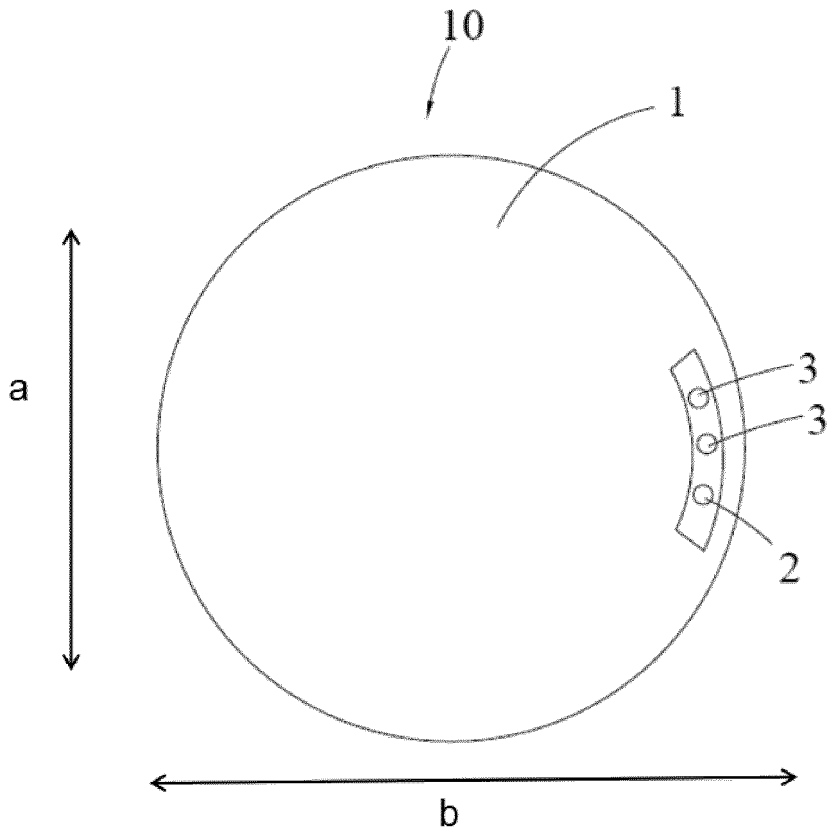

FIG. 1

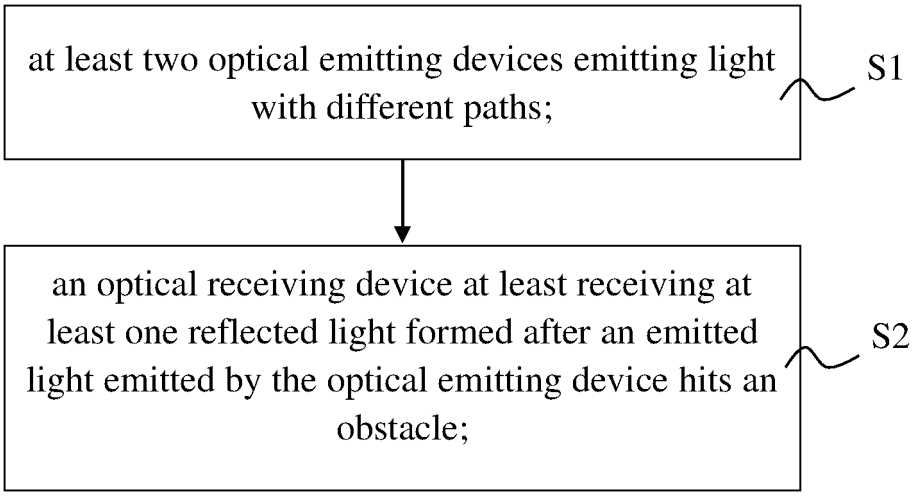
at least two optical emitting devices emitting light with different paths;
S1
an optical receiving device at least receiving at least one reflected light formed after an emitted light emitted by the optical emitting device hits an obstacle;
S2

FIG. 2

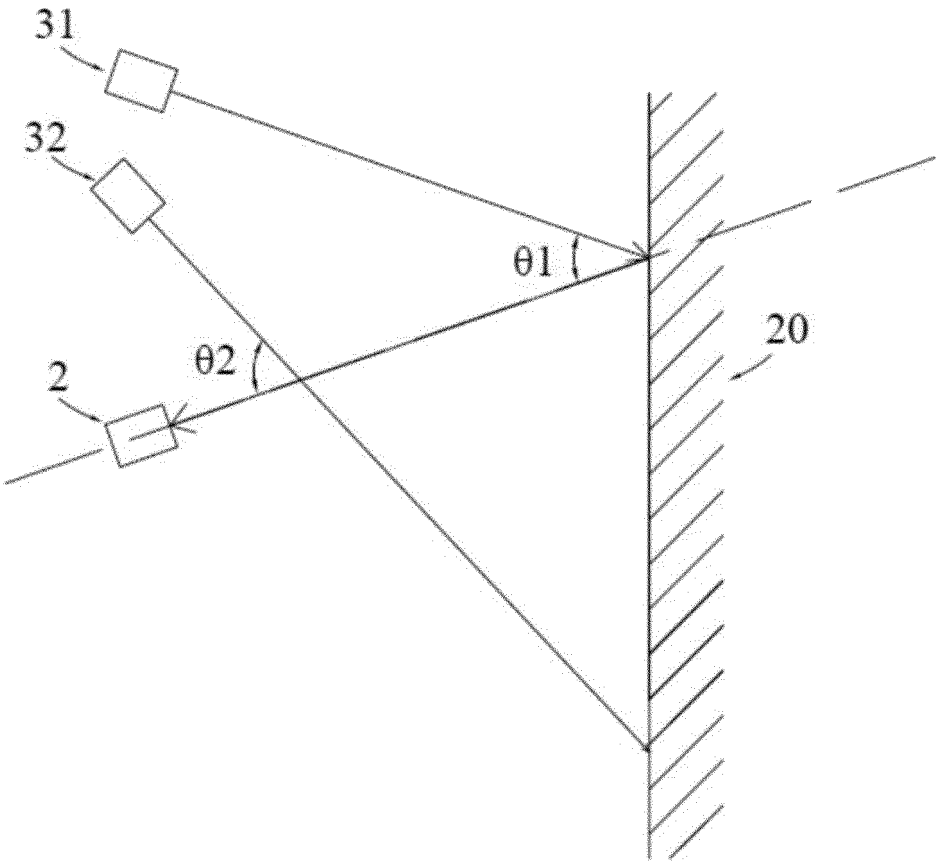

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/132523

A. CLASSIFICATION OF SUBJECT MATTER

G05D 1/02(2020.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G05D1/02; G01V8/20; G01S17/-; G01S7/-; A47L9/-; A47L11/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI; CNPAT; WPI; EPODOC: 追创科技, 机器人, 自移动, 清洁, 清扫, 扫地, 距离, 测距, 接近, 近接, 第一 3w 发射, 第二 3w 发射, 障碍, 避障, 一 3w 接收, 光, 红外, 角, 方向, robot, self w mov+, distance, range, ranging, proximity, clean+, clear+, sweep+, first 2w (transmit+ or send+), second 2w (transmit+ or send+), optic+, light, laser, infrared, angle, direction, obstacle?, barrier?, obstruction

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 111240336 A (ZHUICHUANG TECHNOLOGY (SUZHOU) CO., LTD.) 05 June 2020 (2020-06-05) claims 1-10, description paragraphs [0018], [0025]-[0043]	1-13
Y	CN 103941307 A (SUZHOU EUP ELECTRIC CO., LTD.) 23 July 2014 (2014-07-23) description, particular embodiments, and figures 1-6	1-13
Y	US 4659922 A (EATON CORPORATION) 21 April 1987 (1987-04-21) description column 1 lines 6-15, column 1 line 56- column 2 line 11, column 2 line 39-column 4 line 4, figure 1	1-13
Y	CN 102645654 A (PEGATRON CORPORATION) 22 August 2012 (2012-08-22) description, particular embodiments, and figures 1-4	3, 11-13
A	CN 105404298 A (IROBOT CORPORATION) 16 March 2016 (2016-03-16) description paragraphs [0045], [0051]-[0052], [0060], [0063], [0065], [0099], [0104]-[0111], [0120], figures 1-7B, 9B	1-2, 4-6, 8-10, 13
A	KR 20090019480 A (ACEROBOT CO., LTD.) 25 February 2009 (2009-02-25) description, paragraphs 39-62, and figures 5-8	3, 11

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 February 2021	**26 February 2021**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/132523

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 107045352 A (ZHUHAI AMICRO SEMICONDUCTOR CO., LTD.) 15 August 2017 (2017-08-15) entire document	1-13

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/132523

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 111240336 A	05 June 2020	None	
CN 103941307 A	23 July 2014	CN 103941307 B	16 February 2018
US 4659922 A	21 April 1987	None	
CN 102645654 A	22 August 2012	CN 102645654 B	12 March 2014
CN 105404298 A	16 March 2016	CA 2868860 C	24 April 2018
		US 10429851 B2	01 October 2019
		JP 2015517162 A	18 June 2015
		JP 6675373 B2	01 April 2020
		JP 2016076248 A	12 May 2016
		CA 2868860 A1	27 March 2014
		EP 2834048 B1	01 November 2017
		WO 2014047557 A1	27 March 2014
		JP 5885147 B2	15 March 2016
		AU 2013317738 B2	07 May 2015
		CN 104245244 B	20 January 2016
		JP 6250617 B2	20 December 2017
		EP 3287242 A1	28 February 2018
		CN 104245244 A	24 December 2014
		JP 2018028947 A	22 February 2018
		US 2014088761 A1	27 March 2014
		US 2014257622 A1	11 September 2014
		US 2017031366 A1	02 February 2017
		US 8862271 B2	14 October 2014
		CN 105404298 B	16 October 2018
		EP 2834048 A1	11 February 2015
		US 9442488 B2	13 September 2016
		AU 2013317738 A1	16 October 2014
KR 20090019480 A	25 February 2009	None	
CN 107045352 A	15 August 2017	None	

Form PCT/ISA/210 (patent family annex) (January 2015)